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ABSTRACT

This guidebook is one in a series of teacher inservice materials. It is an effort to translate the findings of a study of problem-solving instruction in grade 7 into a set of materials that provide teachers with new knowledge about mathematical problem solving, current instructional practices, and recommendations for problem-solving instruction. This booklet was designed to help teachers guide students in work with word problems of the type found routinely in mathematics textbooks. It introduces one way to think about problem solving that teachers may find useful as a framework for organizing instruction. It also suggests exercises, problems, and classroom activities to involve students in problem analysis, a critical stage of problem solving. Types of problems, relative difficulty, and common errors are noted first, followed by a model of problem solving that splits the process into problem-analysis and problem-solution phases. Implications for instruction are discussed. Appendix A contains materials designed to involve students in four problem-analysis skills; for each skill, three to six student activities and a series of exercise questions are given. Appendix B lists whole number and fraction word problems as a resource for developing new activities and exercises. (MNS)

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ARITHMETIC WORD PROBLEMS

Activities to Engage Students in Problem Analysis

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August 31, 1985

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Preface

This guidebook is part of a series of teacher inservice materials produced by the Secondary Science and Mathematics Improvement (SSAMI) Program at the Far West Laboratory for Educational Research and Development. During the 1983-1984 school year, one of the ongoing projects of SSAMI was a study of problem-solving instruction in seventh-grade classrooms, the Problem Solving in Intermediate Mathematics Study. This booklet, and two others in the series, represent an effort to translate the background and findings of the study into a set of materials that provide teachers with new knowledge about mathematical problem solving, current instructional practices, and recommendations for problem-solving instruction. The booklets are:

1. Arithmetic Word Problems: Activities to Engage Students in Problem Analysis

2. A Look at Math Teachers and Problem-Solving: A Summary of a SSAMI Research Study

3. Ideas on Teaching Problem Solving in Intermediate Mathematics

We thank the teachers and students who took part in the study of problem solving for allowing observers into their classrooms, for answering our questions, and for sharing their ideas about problem solving. We also thank Dr. John Taylor, Teaching and Learning Division, National Institute of Education, for his support in this and other work. His interest in exploring innovative ways of approaching the problems that confront educators and his encouragement of educational excellence are appreciated.

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ARITHMETIC WORD PROBLEMS

In recent years, problem solving has become an important topic for mathematics education. Educators have recognized that mathematics instruction, particularly at elementary and intermediate levels, focuses on computation and algorithmic skills. Many teachers would now like to incorporate instruction in problem solving into their mathematics curricula.

This booklet was designed to help teachers guide students in work with word problems, the type of problems found routinely in arithmetic textbooks. It introduces one way to think about problem solving that teachers may find useful as a framework for organizing instruction. In addition, it suggests exercises, problems, and classroom activities to involve students in problem analysis, a critical stage of problem solving.

A Need for Instruction in Word Problems

Word problems summarize a situation familiar to students, and ask a question about the situation. For example: John bought four record albums at a cost of $7 each. How much did he pay? To solve a word problem students typically translate the problem into a mathematical form, perhaps a number sentence, and then carry out the operations required to reach a solution.

Word problems are only one type of problem that arithmetic programs may cover. Table 1 gives examples for four types of problems: word, process, applied, and puzzle problems. A comprehensive mathematics program would include many types of problems because different types of problems are likely to develop different skills. Process problems offer students the experience of discovering solution paths, applied problems provide a rich context for organizing and evaluating information, and puzzle problems demonstrate the importance of flexibility and insight.

Word problems are important because they provide students an opportunity to apply recently learned concepts and skills in a simple, supposedly easy-to-understand problem format. When students work with word problems they can practice problem-solving skills useful in other situations.

Relative Difficulty of Word Problems

Word problems are difficult for many students--even students who have a sound foundation in compuational skills. For example, the problems in Figure 1 appeared in a nationwide survey of student achievement conducted by the National Assessment of Educational Progress.[1] In this survey, 13-year olds were asked to compute the product of two fractions and to solve a word problem requiring the same

TABLE 1

TYPES OF PROBLEMS

WORD PROBLEMS

In word problems students translate information into a mathematical form, perhaps a number sentence, and then find a single answer. Usually word problems summarize situations familiar to students. Textbooks contain many examples.

Example: The cafeteria has 25 tables and 200 chairs. There were 60 students seated for lunch. How many chairs were empty?

PROCESS PROBLEMS

In process problems students need to discover a way to solve the problem; known algorithms are not usually helpful.

Example: Seven boys and five girls were at a party. They decided to play records and dance. How many different couples (1 boy and 1 girl) could be formed?

APPLIED PROBLEMS

Applied problems ask students to use information about a realistic situation to reach a decision. A single correct answer is not the goal. Students must organize information and then use it to derive and support a decision.

Example: Given a brochure describing 6 bicycles, their base cost, options, and the cost of options, select a bicycle that meets the buyer's needs and cost constraints..

PUZZLE PROBLEMS

Solutions to puzzles require an unusual view of the problems--a view from a different perspective. Careful analysis of the information is often of little help. Puzzles show students the importance flexibility plays in solving problems.

Example: Place the digits 1-9 in the cells of a 3 X 3 matrix so that the sum of each row and column is 15.

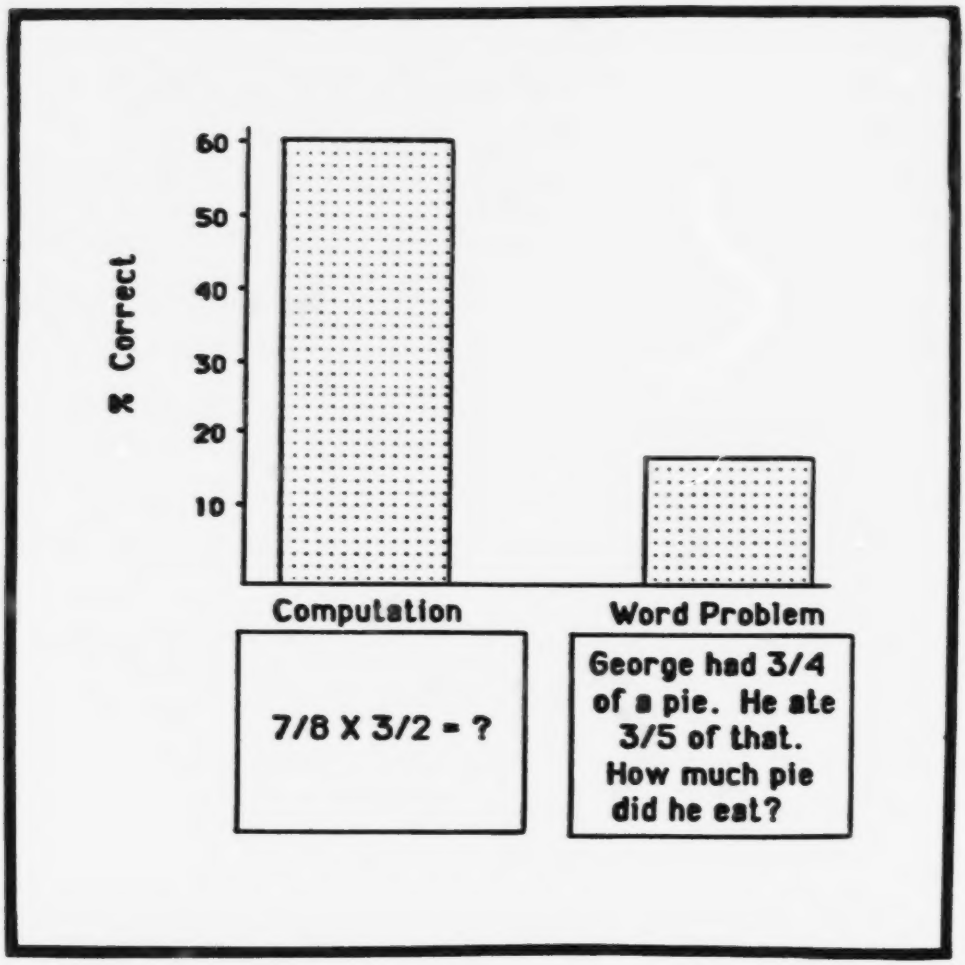


FIGURE 1

RESULTS FOR TWO PROBLEMS

type of computation. Sixty percent of the 13-year olds answered the computation problem correctly, but only 17% answered the word problem correctly.

The pattern of results shown in Figure 1 is not unusual; the California Assessment Program[2] and the Second International Study of Mathematics[3] uncovered similar trends. The results of these surveys indicate that many students who know how to compute when an operation is identified for them encounter trouble in situations where they must identify the operation themselves.

Common Errors

Some students use inappropriate problem-solving strategies when they solve word problems. It is often possible to identify the strategies students use by studying the errors they make. Table 2 lists examples of four common errors:

1. Uses all numbers given. Students will often include in their computations all of the numbers in a problem. These students fail to distinguish relevant from irrelevant information.

2. Stops after one step. A second common error is to complete only the first step of a multiple-step problem. Students who make this error quit before they finish a problem, perhaps because they forget their original goal.

3. Uses key words. Students who rely on key words as the strategy for selecting an operation are misled when the key word gives the wrong clue.

4. Reports an unreasonable answer. It is not unusual for students to give unreasonable -- but computationally accurate -- answers to problems. Stating that 4 2/3 buses are required to carry a group of students is unreasonable, even though the computation may be accurate. This type of error may indicate failure to check the computation results against the question posed in the word problem, or failure to understand the question.

Some Questions to Consider

If your students were tested in computation and problem solving, would their scores result in the pattern shown in Figure 1?

Are the four errors in Table 2 common in your classes?

What are other common errors?

What inappropriate probem-solving strategies might lead to these errors?

TABLE 2

COMMON ERRORS

1. Uses all of the numbers given

   Alice runs 2 miles every day. Her run takes 20 minutes. How many miles does she run in 4 days?

   Incorrect answer: 160

2. Stops after one step.

   Jose worked 4 hours on Saturday and 5 hours on Sunday. He earns $8.00 per hour. How much did he earn in all?

   Incorrect answer: 9

3. Relies on "Key Words"

   Kim collects stamps. On his birthday, his mother gave him 2 stamps, his sister gave him 3 stamps, and his friends gave him some stamps. He received 8 stamps *in all.* How many stamps did Kim's friends give?

   Incorrect answer: 13

4. Reports unreasonable answer

   A school bus holds 30 children. How many busses are needed to transport 140 children?

   Incorrect answer: 4 2/3

A Model of Problem Solving

Why do students use inappropriate strateigies? What type of instruction can help students learn to solve word problems? To address these questions it is useful to consider steps people may take when they solve problems. Figure 2 shows a general two-stage model of problem solving that describes an important feature about the way we approach problems: We spend time analyzing problems before we attempt a solution.

The simple two-stage model splits the process of problem solving into a problem-analysis and a problem-solution phase. During problem analysis we work to understand a problem. We try to understand the demands and goals of the problem and how to represent the information in a problem in a way that is meaningful to us. A plan for solving a problem is a product of problem analysis.

The plan for solving a problem is carried out in the solution stage. During this stage we complete required operations, evaluate the accuracy of answers, monitor our performance, and check to see if the answers make sense.

What is Problem Analysis?

In order to better understand problem analysis it helps to reflect on the thoughts you have while you attempt to solve a problem. Try solving the two problems listed below. While you're working on them, stop every now and again to think about the strategies you use. Do you ask yourself questions? How do you check your understanding of the problem?

1. Suppose that four people meet at a party and that each person shakes hands with each of the other people just once. How many handshakes will there be?

2. A social psychologist was interested in the custom of handshaking. He noticed that some people are more inclined than others to shake hands when they are introduced. One evening when he and his wife had joined four other couples at a party, he took advantage of the occasion to collect data. He asked each of the other nine people at the party how many people they had shaken hands with during the introductions. He received a different answer, from zero through eight, from each of the nine people. You can assume that husbands and wives don't shake hands with each other during introductions, and, of course, people don't shake hands with themselves. Given this information, find out how often the psychologist's wife shook hands.[4]

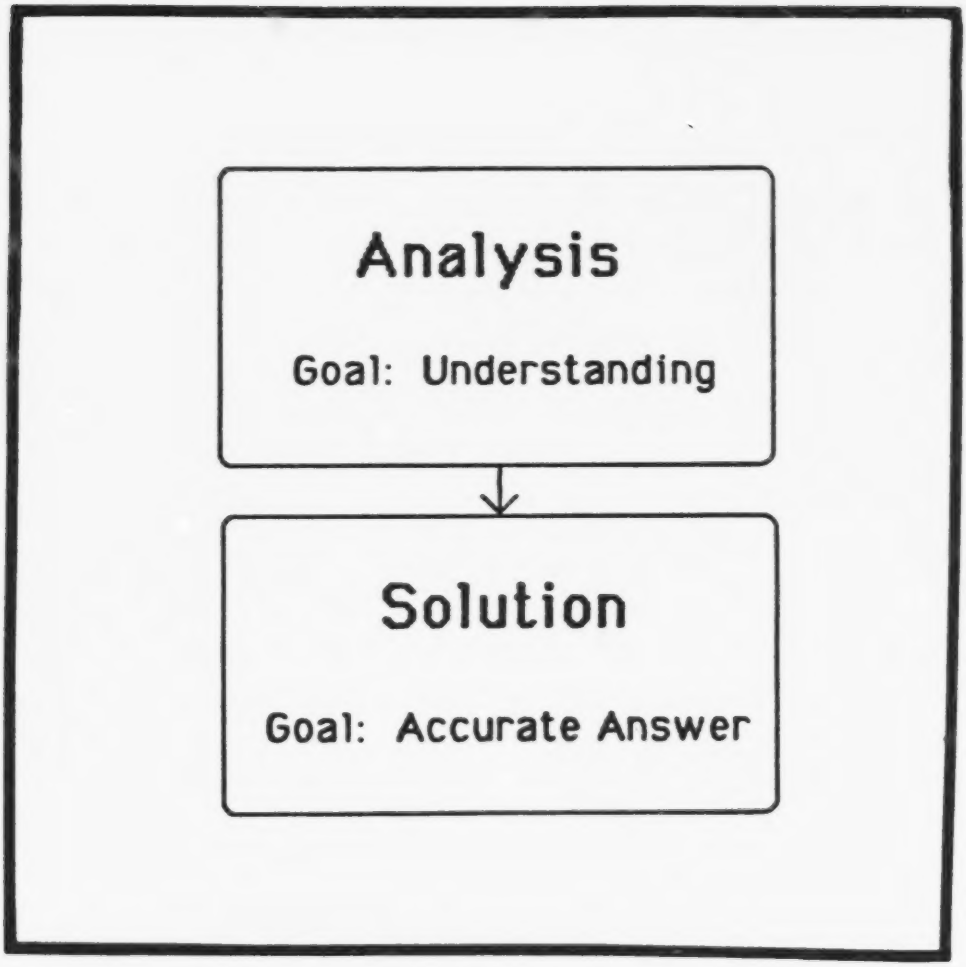


FIGURE 2

PROBLEM-SOLVING STAGES

The handshake problems are difficult for adults as well as for children. The goals of the problems are clear, but the methods for solving the problems are not obvious. For most adults, these process problems require careful analysis. The second problem in particular surprises many people because on first reading it does not seem to give enough information to solve the problem. Did you find yourself asking questions like these when you analyzed the problem?:

Where should I begin?

What information is important?

Is it possible to solve the problem?

How can I organize this information?

The skills used to analyze and solve process problems like the handshake problems are skills students could apply to word problems. Table 2 lists a few skills for each stage of the general model. You may have used some of these skills when you attempted the handshake problems. What other skills would you you add to this list?

Implications for Instruction

The two-stage model of problem solving does not describe the complexity of mathematical problem solving, but it makes a useful distinction that focuses attention on problem analysis. This distinction helps to explain differences in the way people approach problems and how instruction may guide students toward successful problem solving.

People differ in the emphasis they place on problem analysis. Experienced problem solvers spend more time analyzing problems than solving problems (Figure 3). In contrast, inexperienced and unsuccessful problem solvers tend to rush to the solution stage before they fully analyze the problem. For example, inexperienced problem solvers are likely to carry out computations before they identify the relevant numbers in a problem.

Students who have difficulty solving word problems may be failing to analyze problems carefully. The pattern of results from surveys of student achievement suggests this may be so, as do the errors students make on word problems. Students who have the necessary computational skills will fail to solve problems if they fail to analyze problems carefully. Skills that might assist or enable students to analyze problems are good candidates for classroom instruction.

TABLE 3

PROBLEM-SOLVING STAGES WITH RELATED SKILLS

ANALYSIS STAGE

IDENTIFY INFORMATION NECESSARY TO SOLVE A WORD PROBLEM THAT IS NOT IN THE PROBLEM STATEMENT

SEPARATE RELEVANT NUMERICAL INFORMATION FROM IRRELEVANT NUMERICAL INFORMATION IN THE PROBLEM STATEMENT

ESTABLISH SUB-GOALS; IDENTIFY INTERMEDIATE STEPS IN A MULTIPLE-STEP PROBLEM

REPRESENT THE INFORMATION IN A PROBLEM STATEMENT THROUGH A TABLE OR DIAGRAM

SOLUTION STAGE

FOLLOW THE PLAN GENERATED ABOVE

CHECK THE ACCURACY OF THE COMPUTATIONS

CHECK TO SEE IF MORE WORK IS NEEDED

CHECK TO SEE IF THE ANSWER MAKES SENSE

DRAW CONCLUSIONS BASED ON THE COMPUTATIONS

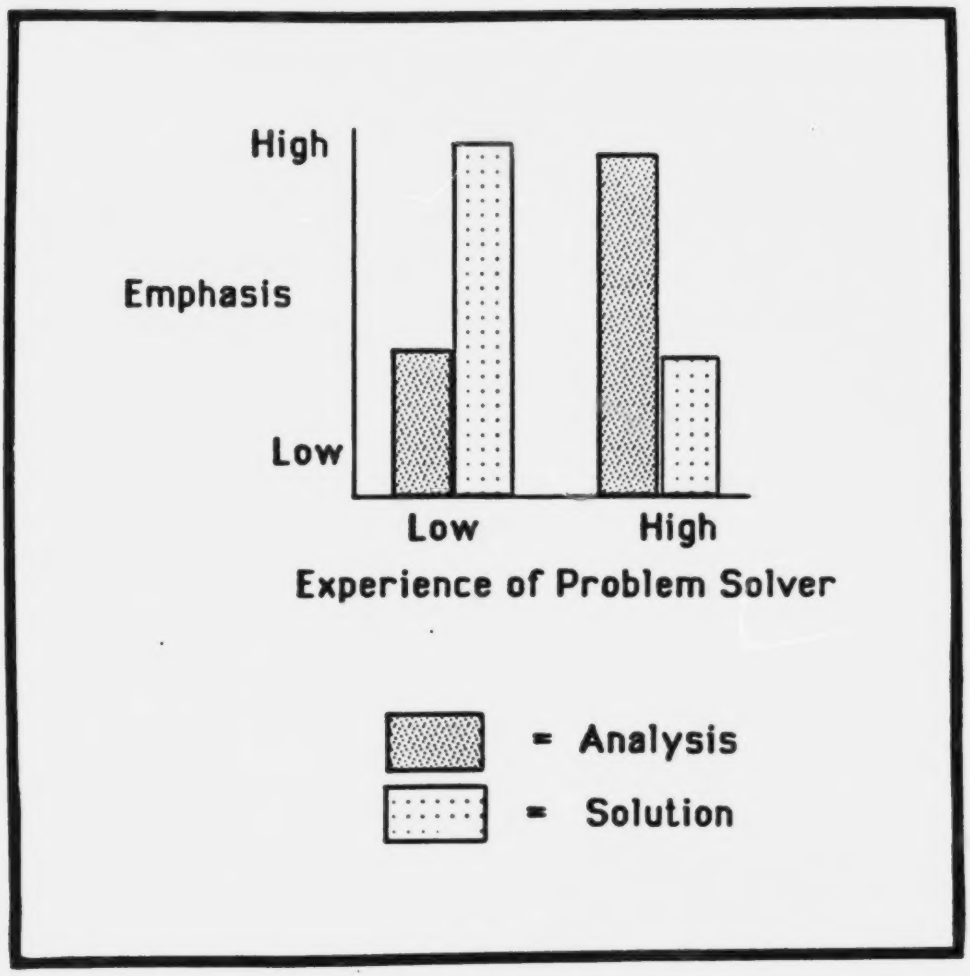


FIGURE 3

EMPHASIS ON PROBLEM-SOLVING STAGES

A Guide to Selected Instructional Materials

As part of our research project on problem-solving instruction, we collected and developed samples of classroom activites and exercises related to problem analysis. The samples, contained in the appendices, should stimulate classroom discussion about the four problem-analysis skills listed in Table 3. The materials also may suggest ideas for instruction in other problem-solving skills.

Appendix A contains materials designed specifically to involve students in the four problem-analysis skills. For each skill it lists 3-6 student activities and a series of exercise questions. The exercises direct students to use a particular skill in analyzing the information in a word problem.

Appendix B is a resource for developing new classroom activities and exercises. It lists whole-number and fraction word problems. The problems are organized by the operation required to solve the problem, and whether or not it contains unnecessary numerical information.

Footnotes

[1] National Assessment of Educational Progress. (1983). The third national mathematics assessment: Results, trends, and issues. (Report No. 13-MA-01). Denver: Author.

[2] California Assessment Program. (1983). Student achievement in California Schools. (1982-83 Annual Report). Sacramento: California State Department of Education.

[3] Crosswhite, F. J., Dossey, J. A., Swafford, J. O., McKnight, C. C., & Cooney, T. J. (1985). The second international mathematics summary report for the United States. Champaign, IL: Stipes Publishing Company.

[4] John R. Hayes discusses this problem in detail in his book The Complete Problem Solver published in 1981 by Franklin Institute Press.

APPENDIX A

Activities and Exercises for Four Problem-Analysis Skills

SKILL 1

PROBLEM-ANALYSIS SKILL:

Identify information necessary to solve a problem that is not in the problem statement.

Sample Exercise: What do you need to know in order to solve this problem?

Mick bought 4 boxes of pencils for $3.00.
How many pencils did he buy?

Answer: The number of pencils in a box.

Activities:

1. Give students a partial problem, like the one in the exercise above, and three facts related to the problem. The students' task is to select the fact that is needed to solve the problem. For example, three facts related to the exercise above are:

   The pencils were on sale for 20% off.
   There are 20 pencils to a box.
   One package of pencils contains 4 boxes.

2. Create a list of "incomplete" problems and a list of "necessary" facts and ask students to match the facts to the problems.

3. Have students write incomplete problems by starting from scratch or with a whole word problem.

WHAT FACT COULD YOU USE?

Each item in this section gives a math problem and three facts about the problem. All the facts are correct, but only one fact will help you solve the problem. Read the item and decide which fact you could use to solve the math problem. Circle the letter of the answer that you select.

A salesman earns $70 for each refrigerator that he sells. What fact could you use to figure out how much money the salesman earned on a certain day?

a. A refrigerator costs $700.
b. The salesman sold 6 refrigerators.
c. The salesman earns 1/10 the cost of a refrigerator.

Sharon had a spelling test on Tuesday and another spelling test on Friday. She got 27 words correct on Tuesday and 25 words correct on Friday. What fact could you use to figure out the total number of words Sharon missed on these two tests?

a. There were 30 words on each test.
b. Sharon scored 90% on Tuesday's test.
c. Only 2 students scored higher than Sharon.

Mr. Raymond is going to drive from San Francisco to Lake Tahoe by going through Sacramento. The drive to Sacramento takes about 2 hours. What fact could you use to figure out how long the entire trip to Lake Tahoe will take?

a. Sacramento is 80 miles from San Francisco.
b. The drive from Sacramento to Lake Tahoe takes about 2 hours.
c. Mr. Raymond plans to drive at 55 miles per hour.

Peter loaned his sister $3 but still had enough money to bowl 3 games. What fact could you use to figure out the cost of bowling one game?

a. Peter bowled 2 games before he loaned money to his sister.
b. Peter's allowance is $10 per week.
c. Peter started with enough money to bowl 6 games.

Susan read a book over the weekend. On Friday night she read 80 pages in 2 hours. On Saturday she read 125 pages in 3 hours. Susan finished the book on Sunday. What fact could you use to figure out how many hours Susan read on Sunday.

a. Over the weekend Susan spent 8 hours reading the book.
b. The book was 325 pages long.
c. Susan read about 40 pages per hour on Sunday afternoon.

The Jones family drove 250 miles on their vacation and used one tank of gasoline. Gasoline costs $1 per gallon. What fact could you use to figure out how much money the Jones family spent on gasoline?

a. They drove an average speed of 50 miles per hour.
b. They drove for 5 hours.
c. Their gas tank holds 12 gallons of gasoline.

Mr. Smith bought a video player for $100 and some video games. He spent a total of $160. What fact could you use to figure out how many games he bought?

a. The video player was on sale for 20% off.
b. The games cost $20 each.
c. Mr. Smith had $200 to spend.

The members of a club decided to share the cost of a party. Each member brought $5. Food for the party cost $25. What fact could you use to figure out how much money the members have left after they pay for the food?

a. There are 7 members in the club.
b. Decorations for the party cost $10.
c. The members invited 25 people to the party.

Sherry and Damon work at a restaurant on the weekends. Last week, Sherry worked 10 hours and earned $35. Damon worked more hours and earned $54. What fact could you use to figure out how many hours Damon worked?

a. Damon earned $19 more than Sherry last week.
b. Sherry worked 6 hours on Saturday.
c. Damon earns $1 more per hour than Sherry.

A club had a bake sale on Saturday. In the morning they charged $2 per cake. In the afternoon, they charged $1 per cake and they sold twice as many cakes as in the morning. What fact could you use to figure out how much money the club collected on Saturday?

a. The club reduced the price of cakes by 50%.
b. The club sold 10 cakes in the morning.
c. The club spent $5 for supplies.

A salesman earns $80 for each motorcycle that he sells. What fact could you use to figure out how many motorcycles he sold on a certain day?

a. A motorcycle costs $1600.
b. The salesman earned $160 that day.
c. The salesman earns 1/20 the cost of a motorcycle.

Betty started a book on Friday night and read the first 50 pages in 2 hours. On Saturday she read 90 pages in 3 hours. Betty finished the book on Sunday. What fact could you use to figure out how many pages Betty read on Sunday?

a. Betty read for 4 hours on Sunday.
b. The book was 200 pages long.
c. Betty read about 20 pages per hour on Sunday.

John lost $2 but still had enough money to play 10 video games. What fact could you use to figure out the cost of playing one video game?

a. John played 3 video games before he lost the money.
b. John's allowance is $5 per week.
c. John started with enough money to play 14 video games.

Andy had one math test on Monday and one on Friday. He missed 4 problems on Monday and 3 on Friday. What fact could you use to figure out the total number of problems that Andy answered correctly on these two tests?

a. There were 20 problems on each test.
b. Andy scored 80% on Monday's test.
c. Only five people scored higher than Andy.

Alex bought a tape recorder that cost $60 and he bought some tapes. He spent a total of $80. What fact could you use to figure out how many tapes Alex bought?

a. The tape recorder was on sale for 1/2 off.
b. The tapes cost $4 each.
c. Alex had $100 to spend.

Joe and Alice work at a store part-time. Last week, Joe worked 8 hours and earned $64. Alice worked more hours and earned $72. What fact could you use to figure out how many hours Alice worked?

a. Alice earns $16 more than Joe each week.
b. Joe works 2 hours each afternoon.
c. Joe earns $2 more per hour than Alice.

A group of young girls sold lemonade on Saturday. In the morning, they charged 50 cents per glass. In the afternoon, they charged 25 cents per glass, and they sold twice as many glasses as in the morning. What fact could you use to figure out how much money the girls collected on Saturday?

a. The girls reduced the price of lemonade by 50%.
b. They sold 20 glasses of lemonade in the morning.
c. They spent $5 on supplies.

SKILL 2

PROBLEM-ANALYSIS SKILL:

Separate relevant numerical information from irrelevant numerical information in the problem statement.

Sample Exercise: Read the word problem and circle the numbers you will need to solve the problem.

Jason spent (3/4) hour cutting the lawn and (1/2) hour helping his mother trim 4 bushes in the yard. How many hours did he work?

Activities:

1. Ask students to create problems containing numerical information that is not needed to solve the problem. Let students start from scratch or add information to an existing problem.

2. Give students a mixture of problems, only some of which contain irrelevant numerical information. Ask the students to identify the problems with "too much information."

3. Have students write down three or four facts about themselves on a piece of paper. Then ask the students questions that can be answered with some, but not all, of the facts. The students' task is to tell you which fact(s) they need to answer each question that you ask. For example, ask students to write this information on their papers:

   a. The distance from home to school.

   b. How long it takes to travel to school.

   c. What time the student leaves home.

   Then ask:

   a. What is your average speed of travel to school?

   b. What time do you arrive at school?

4. After students read a newspaper article that contains numerical information, have them find the information in the article that they need to answer questions you (or other students) ask.

FINDING IMPORTANT INFORMATION

The problems in this section give more numbers than you need to solve the problems. Read each problem, decide which numbers you would use to solve the problem, and circle those numbers. Only circle the numbers necessary to answer the question.

Leslie has 75 coins in her collection. For her birthday, her mother gave her 5 coins, her brother gave her 2 coins, and her aunt sent her 4 coins. How many coins did she get for her birthday?

At Franklin High School there are 500 students and 80 teachers. If 270 students are girls, how many students are boys?

Jerry did work for 3 of his neighbors last week. He was paid $4 per hour and worked 6 hours. Then he spent $8 of the money he earned. How much money did he have left?

A store hired 2 boys to unpack some cartons. The boys worked 4 hours and the owner of the store paid them $26. The boys shared their earnings equally. How much did each boy make?

A theater had 600 seats in 20 rows. Workers installed 7 new rows of seats with 35 seats in each row. How many new seats did the workers install?

Denise worked 15 hours last week. She earned $10 baby-sitting and washed 4 cars at $3 each. How much more money does she need to buy a $30 sweater?

A football team scored 200 points in the 8 games they won and 84 points in the games they lost. The team played 12 games during the season. What was their average number of points per game?

There are 62 children and 9 counselors at a summer camp. If there are 30 girls attending the camp, how many children are boys?

George has 140 stamps in his collection. For Christmas his grandmother sent him 18 stamps, his brother gave him 8 stamps, and his sister gave him 7 stamps. How many stamps did he get for Christmas?

Saturday morning Jack played 9 video games that cost 50 cents each. Then, in the afternoon, he played 6 other games that cost 25 cents each. How many games did he play in all?

Chris baby-sat the Mandlers' 2 children for 4 hours last Saturday night. He was paid $3 per hour. He gave his sister $5 of the money he earned. How much money did he have left?

Mrs. Collins hired 2 boys to clean out her basement. It took the boys 3 hours and Mrs. Collins paid them a total of $16. The boys had agreed to share their earnings equally. How much did each boy make?

Tickets to the class play cost $4 for students and $5 for adults. Mr. Michaels bought 3 student tickets and 4 adult tickets. How much did he spend for adult tickets?

A man plans to paint his living room and den. It will take him 6 hours to paint the living room and 2 hours to paint the den. He painted for 4 hours, rested 2 hours, and then painted 2 more hours. How many hours must he work to finish painting the rooms?

A concert hall had 800 seats. Workers put in 5 more rows of seats with 40 seats in each row. How many new seats did the workers install?

Sharon worked 20 hours last week. She earned $15 running errands and mowed 5 lawns at $4 each. How much more money does she need to buy a $40 watch?

A baseball team played 110 games. They scored 200 runs in the 65 games that they won, and 100 runs in the games that they lost. What is their average number of runs per game played?

SKILL 3

PROBLEM-ANALYSIS SKILL:

Identify intermediate steps in a multiple-step problem.

Sample Exercise: Before you can solve this problem, what question must you answer?

A grocer buys a crate of 360 eggs for $40.
How much is he paying per dozen?

Answer: How many dozen eggs in a crate?

Activities:

1. Present students with a pair of problems that have similar content but require a different number of steps for solution. Ask the students to compare the problems and discuss the differences. For example:

There were 462 boys in an auditorium. There were twice as many girls in the auditorium. How many girls were there?	There were 462 boys in an auditorium. There were twice as many girls in the auditorium. Two boys and 4 girls were called out by the principal. How many girls were left in the auditorium?

2. Have students write multiple-step problems by starting from scratch or building on a one-step problem.

3. Ask students to break a multiple-step problem into separate one-step problems. For the "egg" problem in the exercise above, students would find two problems:

A grocer buys a crate of 360 eggs. How many dozen eggs does he buy?	A grocer buys 30 dozen eggs for $40. How much is he paying per dozen?

4. Give students a list of problems that include one-step and multiple-step problems. Ask them to identify the problems that have a "hidden question."

5. Work with one multiple-step problem. Give students facts related to the situation in the problem and ask students which fact they need to solve the problem. Then have them tell you how to find that fact in the problem. These facts could be given for the "auditorium" problem in #1 above:

The auditorium holds 1200 people.
There were 924 girls in the auditorium.
2/3 of the people in the auditorium are girls.

FINDING THE HIDDEN QUESTION

Problems can have a hidden question whose answer is needed before you can answer the main question in the problem. Read each problem, decide which question you would need to answer before you could solve the problem, and circle the letter of the question that you select.

A large bus can carry 75 people. A small bus can carry 42 people. How many people in all can be carried by 5 large buses and 1 small bus?

Which question do you need to answer before you can solve this problem?

a. How many people can 5 large buses carry?
b. How many people can 1 large and 1 small bus carry?
c. How many people need to travel by bus?

Tony agreed to paint a fence for $45. If he spends $3 for a paint brush and $15 for paint, how much profit will he make?

Which question do you need to answer before you can solve this problem?

a. How many hours does Tony work?
b. What was the total amount that Tony spends on supplies?
c. What is the difference between the cost of the paint and the cost of the brush?

A nature club hiked 4 hours in the morning and 3 hours in the afternoon. They hiked a total distance of 35 miles. On the average, how far did they walk per hour?

Which question do you need to answer before you can solve this problem?

a. How far did they walk in the afternoon?
b. How fast did they walk in the morning?
c. How many hours did they hike?

A large van holds 16 people and a small van holds 12 people. How many people in all can be carried by 6 large vans and 1 small van?

Which question do you need to answer before you can solve this problem?

a. How many people can 1 large van and 1 small van carry?
b. How many people can 6 large vans carry?
c. How many people need to ride in a van?

The members of a travel club bought 60 plane tickets at a special price. Each ticket was $50 less than the regular price of $300. How much money did the club spend for the 60 tickets?

Which question do you need to answer before you can solve this problem?

a. How many tickets were sold at a price of $300?
b. How many club members bought tickets?
c. How much did one ticket cost at the special price?

The Mustangs and the Cardinals are baseball teams. When they played each other, 800 Cardinals' fans came to watch. Twice as many Mustang fans came to the game. How many fans came to the game?

Which question do you need to answer before you can solve this problem?

a. How many Mustang fans came to the game?
b. What fraction of the fans were Mustang fans?
c. How many more Cardinal fans than Mustang fans came to the game?

A store held a sale on Saturday. In the morning they sold coats for $60 each, and they took in a total of $840. In the afternoon they reduced their price to $40 and sold 4 times as many coats. How many coats did the store sell in the afternoon?

Which question do yo need to answer before you can solve this problem?

a. How many customers did the store have on Saturday?
b. How many coats did the store sell in the morning?
c. How much profit did the store make from their sale?

The State of California found that 10,000 people had not paid their state income taxes. The State decided to hold 2 "free weeks" when people could pay their taxes without paying fines. During the first week, 5,000 people paid their taxes and during the second week 3,500 people paid. How many people did not pay?

Which question do you need to answer before you can solve this problem?

a. How much money did the state collect during the first week?
b. How many people paid their taxes during the two weeks?
c. How much does the State collect each year in taxes?

A plumber earns $20 per hour for the first 40 hours of work in a week. She earns $30 per hour for each hour over 40 hours. How much money will she earn in one week if she works 41 hours?

Which question do you need to answer before you can solve this problem?

a. How much does the plumber earn for the first 40 hours?
b. What is the difference between the pay for regular hours and the pay for extra hours?
c. How many hours does the plumber work each day?

A book club gives a $2 discount on each book that a member buys. The club has 750 members. Last month, 200 members bought 3 books, 150 members bought 2 books, and 250 members bought 1 book. What was the total amount of discounts last month?

Which question do you need to answer before you can solve this problem?

a. How much money did members spend on books last month?
b. How many members bought books last month?
c. How many books did members buy last month?

On Wednesday, the Wilsons drove 4 hours in the morning and 5 hours in the afternoon. They traveled a total distance of 495 miles. What was their average speed per hour?

Which question do you need to answer before you can solve this problem?

a. How fast did they travel in the morning?
b. How far did they travel in the afternoon?
c. How many hours did they drive on Wednesday?

Mr. Turner earns $12 per hour for the first 40 hours of work in a week. He earns $18 per hour for each hour over 40 hours. How much money will Mr. Turner earn in one week if he works 41 hours?

Which question do you need to answer before you can solve this problem?

a. How many hours does Mr. Turner work each day?
b. How much does Mr. Turner earn in the first 40 hours?
c. What is the difference between the pay for extra hours and the pay for regular hours?

The school librarian found that 40 books had been borrowed but never returned. She held 2 "free days" on which students could return books without paying fines. Students returned 12 books on the first day and 15 books on the second day. How many books were still missing?

Which question do you need to answer before you can solve this problem?

a. What is the total number of books returned on the free days?
b. How many students returned books on the free days?
c. How many books are in the library?

The Tigers and the Lions are football teams. When they played a game, 300 Tigers' fans came to watch. Twice as many Lions' fans came to the game. How many fans came to the game?

Which question do you need to answer before you can solve this problem?

a. How many Lions' fans came to the game?
b. What percentage of the fans were Lions' fans?
c. How many more Lions' fans than Tigers' fans came to the game?

Margaret opened her new hat shop on Monday. In the morning she sold her hats for $30 each, and she brought in a total of $180. In the afternoon she reduced her price to $20 each and sold three times as many hats. How many hats did Margaret sell in the afternoon?

Which question do you need to answer before you can solve this problem?

a. How many customers did Margaret have on Monday?
b. How much money did Margaret spend on hats?
c. How many hats did Margaret sell in the morning?

A record club has 100 members. The club gives a $3 discount on each record that a member buys. Last month, 50 members bought 3 records each, 30 members bought 2 records each, and 10 members bought 1 record each. What is the total amount of discounts for last month?

Which question do you need to answer before you can solve this problem?

a. How many members bought records last month?
b. How many records did members buy last month?
c. How much did members pay for records last month?

SKILL 4

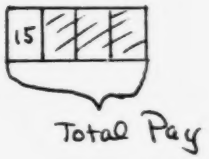
PROBLEM-ANALYSIS SKILL:

Represent the information in a problem statement through a table or a diagram.

Sample Exercise: Draw a diagram that represents the information in this problem:

> John has a part-time job at a grocery store. Last week he spent $15 of his pay on a new sweater. This left him with 3/4 of his weekly salary. How much does John earn each week?

Answer:



Activities:

1. Allow students to act out a word problem and then discuss how to represent their actions in a diagram or table. For example, 3 students could act as the student body of the school in this problem:

   > A school dance was attended by 2/3 of the students in the school. Of those attending, 1/2 had helped decorate the hall. What fraction of the total number of students in the school helped with the decorations?

2. Create a figure or table for each of 10 word problems and ask students to match the representation to the problem.

3. Ask students to generate more than one way of representing a problem and then discuss the representations. Do some representations show relationships that other representations do not show?

4. Ask students to write word problems from diagrams and tables that you give to them.

Use these directions for the exercises that follow:

DISPLAYING THE INFORMATION IN PROBLEMS

When you want to understand a math problem, it helps to draw a picture or make a table that shows the information in the problem. Each item in this section gives a math problem and three different displays, either in pictures or tables. Read the problem, decide which display shows the information in the problem, and circle the letter of the display that you choose.

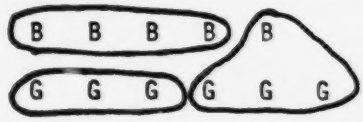
A group of 5 boys and 6 girls rode on the ferris wheel at a carnival. Each car on the ferris wheel can hold 3 people. How many cars did this group need?

Which picture shows the information in the problem?

A.

B.

C.



John and Lonnie are starting record collections. John doesn't have any records at all, but plans on buying 3 records per month. Lonnie has 3 records already, and plans on buying 2 records per month. After 3 months, who will have the most records?

Which table shows the information in the problem?

A.

Month	NUMBER OF RECORDS John	Lonnie
0	0	3
1	3	7
2	6	9
3	9	11

B.

Month	NUMBER OF RECORDS John	Lonnie
0	0	3
1	3	5
2	6	7
3	9	9

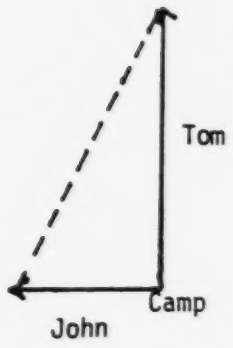
C.

Month	NUMBER OF RECORDS John	Lonnie
0	0	3
1	3	2
2	6	4
3	9	6

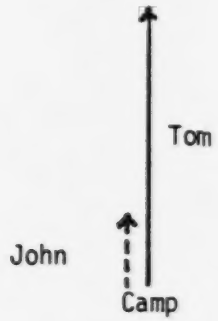
Tom and John went camping. Tom walked north from the campsite for 8 miles. John also walked north from the campsite for 2 miles. How far is Tom from John?

Which picture shows the information in the problem?

A.



B.



C.

A record store is having a sale. If you buy the first record for the normal price of $7, each record after the first only costs $6. In addition, for every 3 records you buy, you get one free. How much would it cost to buy five records?

Which table shows the information in the problem?

A.

Record	Cost
First	$ 7
Second	6
Third	6
Fourth	-0-
Fifth	6

B.

Record	Cost
First	$ 7
Second	6
Third	6
Fourth	6
Fifth	6

C.

Record	Cost
First	$ 7
Second	6
Third	6
Fourth	-0-
Fifth	7

A three minute phone call to New York costs 60 cents. For each minute over 3 minutes, a caller is charged 20 cents per minute. What is the cost of a 5 minute phone call?

Which table shows the information in the problem?

A.

Length of Call in Minutes	Cost of Call
1	$ .60
2	$ .60
3	$ .60
4	$ .20
5	$ .20

B.

Length of Call in Minutes	Cost of Call
3	$ .60
4	$ .80
5	$1.00

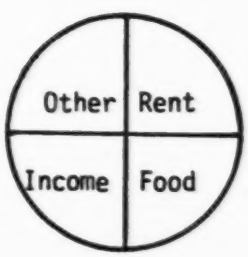
C.

Length of Call in Minutes	Cost of Call
1	$ .60
2	$ .80
3	$1.00
4	$1.20
5	$1.40

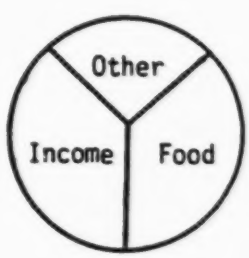
A college student earns $500 per month. Out of this he pays $125 for food and twice that amount for rent. How much money does he have left for other expenses?

Which picture shows the information in the problem?

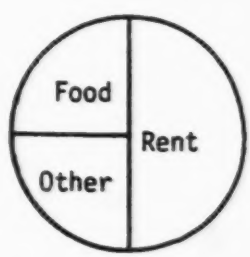
A.



B.



C.



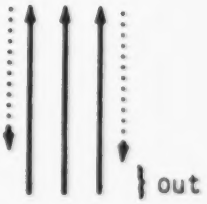
Tom is flying a kite with a string 3000 meters long. First Tom lets out all the string. Then he rolls in 600 meters. Next he lets out 200 meters. Then he lets out another 200 meters. Finally, he rolls in 1500 meters. How much string is still out?

Which picture shows the information in the problem?

A.

B.

C.



The temperature was 36° at 5 a.m. in the morning. The temperature then rose 4° each hour until 8 a.m. It then started to drop 2° each hour. What was the temperature at 11 a.m.?

Which picture shows the information in the problem?

A.

Time:	5 a.m.	7 a.m.	9 a.m.	11 a.m.
Temperature:	36°	40°	42°	40°

B.

Time:	5 a.m.	7 a.m.	9 a.m.	11 a.m.
Temperature:	36°	40°	44°	48°

C.

Time:	5 a.m.	7 a.m.	9 a.m.	11 a.m.
Temperature:	36°	44°	46°	42°

Sue runs 2 miles in 30 minutes. Rae runs 3 miles in 30 minutes. If they start at the same place and run in the same direction, how far apart will they be in 90 minutes?

Which table shows the information in the problem?

A.

	Minutes:	30	60	90
Miles Run:	Sue	2	2	2
	Rae	3	3	3

B.

	Minutes:	30	60	90
Miles Run:	Sue	2	4	6
	Rae	3	6	9

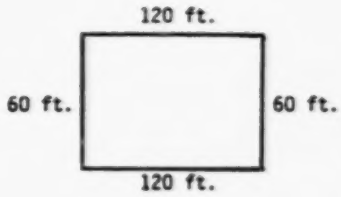
C.

	Minutes:	30	60	90
Miles Run:	Sue	3	5	7
	Rae	3	6	9

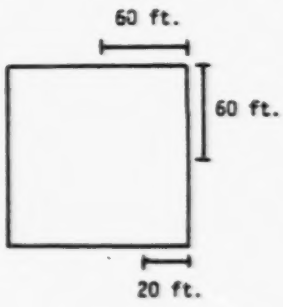
The sections of a fence that surrounds a field are in need of repair. Each side of the field is 120 feet long. On one side, 60 feet of fence needs repair. On another side, 60 more feet need repair. On the third side 20 feet need repair. The fourth side is all right. How many feet of fence are not in need of repair?

Which picture shows the information in the problem?

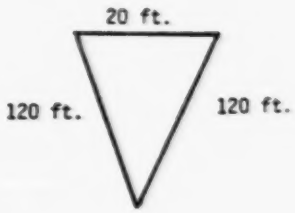
A.



B.



C.

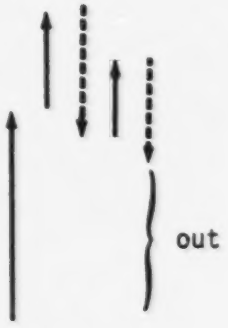


Eric went fishing. He let out 50 feet of fishing line and hooked a big fish. The fish pulled the line out 25 feet more. Eric reeled in 30 feet of line. Then the fish pulled the line back 15 feet. Eric reeled in 20 feet. How much line is still out?

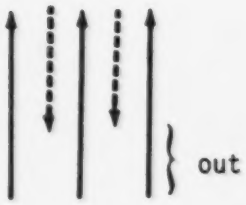
Which picture shows the information in the problem?

A.

B.



C.



A store that rents videotapes is having a special offer. You pay the regular charge of $6 for the first videotape. Each tape after the first only costs $5. Also, for every 4 tapes that you rent, you get one free rental. How much would it cost to rent 5 videotapes?

Which table shows the information in the problem?

A.

Videotape	Rental Charge
First	$6
Second	5
Third	5
Fourth	5
Fifth	-0-

B.

Videotape	Rental Charge
First	$6
Second	5
Third	5
Fourth	5
Fifth	5

C.

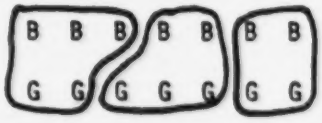
Videotape	Rental Charge
First	$5
Second	5
Third	5
Fourth	5
Fifth	-0-

A group of 7 boys and 7 girls drove to the beach. Each car could hold 5 people. How many cars did they need?

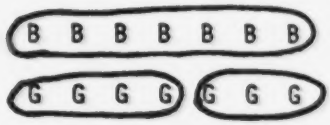
Which picture shows the information in the problem?

A.

B.



C.



Lisa and Mike are starting savings accounts. Lisa has $10 and Mike has $8. Lisa plans to save $5 each month and Mike plans to save $7 each month. After 4 months who will have the most money in their savings account?

Which table shows the information in the problem?

A.

Month	TOTAL IN ACCOUNT Lisa	Mike
0	$ 10	$ 8
1	15	15
2	20	22
3	25	29
4	30	36

B.

Month	TOTAL IN ACCOUNT Lisa	Mike
0	$ 10	$ 8
1	15	20
2	20	27
3	25	34
4	30	41

C.

Month	TOTAL IN ACCOUNT Lisa	Mike
0	$ 10	$ 8
1	15	7
2	20	14
3	25	21
4	30	28

A taxi ride costs $2 for the first 4 miles. For every mile over 4, a passenger is charged 25 cents per mile. What is the cost of a 6 mile ride?

Which table shows the information in the problem?

A.

Length of Trip in Miles	Cost
1	$2.00
2	2.00
3	2.00
4	2.00
5	.25
6	.25

B.

Length of Trip in Miles	Cost
1	$2.00
2	2.25
3	2.50
4	2.75
5	3.00
6	3.25

C.

Length of Trip in Miles	Cost
4	$2.00
5	2.25
6	2.50

A secretary earns $800 a month. Out of this she saves $100 and spends three times that amount for rent. How much money does she have left for other expenses?

Which picture shows the information in the problem?

A.

B.

C.

A motorboat travels 15 miles in 10 minutes. A sail boat travels 5 miles in 10 minutes. If they start at the same place and travel in the same direction, how far apart will they be in 30 minutes?

Which table shows the information in the problem?

A.

	Minutes:	10	20	30
Miles Traveled	Motor-boat	15	30	45
	Sail Boat	5	10	15

B.

	Minutes:	10	20	30
Miles Traveled	Motor-boat	15	15	15
	Sail Boat	5	5	5

C.

	Minutes:	10	20	30
Miles Traveled	Motor-boat	5	20	35
	Sail Boat	15	20	25

APPENDIX B

Word Problems

WHOLE-NUMBER PROBLEMS

Addition

A man drives 22 miles to get to work. To avoid traffic on the way home, he takes a different route and drives 26 miles. How many miles does he drive in a round trip?

Paul has 21 stamps in his collection. If he buys 54 more from a stamp dealer, how many will he have?

Four runners on a relay team ran distances of 200 meters, 275 meters, 150 meters and 100 meters. What was the total distance the team ran?

Mike bought an old car for $1000. He also bought a car radio for $200. How much did he spend?

Jose had 12 record albums in his collection. Then, Jose's brother gave Jose 2 records by Duran Duran and 2 by the Clash for his birthday. How many records did Jose have after his birthday?

Addition with Unnecessary Information

An insurance agent visited 585 customers. He sold 76 life insurance policies, 97 fire insurance policies, and 208 auto insurance policies. How many policies did he sell in all?

A tourist rents a car for $30 a day for 7 days. He has to pay $2 a day for insurance and $10 a day for gasoline. How much does it cost each day for the use of the car?

A housewife bought 2 lbs. of meat for $4, 5 lbs. of potatoes for $1, and a gallon of milk for $2. How much did she spend?

One day a jogger got up at 6:00 a.m. and ran 3 miles before going to work. He got home from work at 5:00 p.m. and rested for 1 hour. Before dinner he ran 2 more miles. How many miles did he run on that day?

Mrs. Smith promised to do 25 hours of volunteer work during April. On April 2 she worked 7 hours. On April 10 she worked 6 hours, and on April 30 she worked 9 hours. How many hours did she work in April?

A school bus has 62 seats. At the first stop, 8 children got on. At the second stop, 11 children got on. At the third stop, 37 children got on. How many children got on the bus?

Alice collects coins. She has 45 coins in her collection. For her birthday, her grandmother sent her 6 coins, her sister gave her 3 coins, and her best friend gave her 2 coins. How many coins did she get for her birthday?

Each student in a 7th-grade class was supposed to sell 20 tickets to a class dance. Alex sold 7 tickets the first week and 11 tickets the second week. How many tickets did Alex sell during the two weeks?

Sue typed 3 pages in 30 minutes. She typed the next 5 pages in 45 minutes. How long did it take her to type these 8 pages?

The gas tank in Dan's car holds 20 gallons. He used 4 gallons to take his mother shopping and 5 gallons to go to the beach. How many gallons of gas did he use?

One morning Robert played 10 video games that cost 25 cents each. Then, in the afternoon, he played 5 other games that cost 50 cents each. How many games did he play in all?

Jeremy played one game of Pac Man on Tuesday and one game on Wednesday. In his first game he scored 1500 points, in the second 2000. What is the total number of points he scored in those two games?

Last year a lawyer won 12 cases and lost 6. This year she won 15 and lost 8. How many cases did she win in these two years?

Star Wars played at the movie theater in town for 15 months. Ron saw it 3 times, his sister saw it 7 times, and his brother saw it 4 more times than Ron. How many times did Ron's brother see Star Wars?

Subtraction

A classroom is 13 meters long. Its width is 2 meters less than its length. How wide is the room?

Joe had 22 problems for math homework. He did 7 problems at school. How many problems did he have to do at home?

There are 54 children at a small summer camp. If there are 33 boys attending the camp, how many campers are girls?

Martha's teacher assigned 75 pages of reading over the week-end. Martha read the first 40 pages on Saturday. How many pages did she need to read on Sunday in order to finish the book?

Alex and Maddy counted their record albums. Alex owned 26 fewer records than Maddy who owned 72 records. How many records did Alex own?

Last year the Garcia family spent 14 days camping in Yosemite. This year they spent 21 days camping at the Trinity Alps. How many days longer was their vacation this year than last?

When the Clash played a concert in Fresno, 5762 attended. When they played in San Francisco, 8946 people attended the concert. How many more people attended the concert in San Francisco than in Fresno?

Subtraction with Unnecessary Information

The Science Club earned $84 from a plant sale. Their expenses were $12 and they sold 27 plants. How much profit did the club make?

Lou had $400 in a savings account. Before Christmas he took out $75 to buy presents. After Christmas he deposited $85. How much more money does he have in his account now?

Lisa, Ginny, and Marge collect stamps. Lisa has 267 stamps, Ginny has 298 stamps, and Marge has 332 stamps. How many more stamps does Ginny have than Lisa?

Doug bought a can of 3 tennis balls for $2. He gave the clerk a five dollar bill. How much change did he get back?

A class bought 50 cans of nuts at $1 a can. They sold them for $2 a can. How much money did the class make on each can of nuts they sold?

In the 1980 presidential election in California, Reagan received about 4,500,000 votes. Carter received about 3,000,000 votes and minor candidates received 400,000 votes. How many more votes did Reagan receive than Carter?

A computer store sells a package of 10 computer disks for $50. Purchased separately, 10 disks would cost $60. How much do you save by buying the package?

Alice and Michael planned to make 25 necklaces to sell at a craft show. Alice made 10 necklaces and Michael made 12. How many more necklaces did Michael make than Alice?

John had enough money to play 15 video games. The games cost 25 cents each. If John gave his sister enough money to play 6 games, how many games could John play?

There are 2 record stores in town: Pop Records and Top Records. Pop charges $8 for each record you buy. Top charges $10 for one record, $16 for two records, and $18 for three records. If you only wanted one record, how much would you save by buying it at Pop's?

Multiplication

A taxicab company bought 4 new tires for each taxi. The company owns 37 taxis. How many tires did the company buy?

At an elementary school, there are 27 students in each classroom. There are 16 classrooms in the school. What is the total number of students in the school?

A salesman receives $65 for each dishwasher that he sells. If he sold 8 dishwashers last week how much money did he make?

Mrs. Armstrong bought 110 shares of stock at $22 per share. What was her cost for the stock?

An auto repair shop charges $25 per hour for labor. A mechanic worked on Mr. Long's car for 3 hours. What was the total charge for labor?

A car traveled for 7 hours at an average speed of 48 miles per hour. How far did the car travel?

A basketball team scored an average of 92 points per game. If they played 17 games during the season, what was the total number of points that they scored?

A man earns $12 per hour. How much will he earn in a week if he works 40 hours?

If a woman can weave a small rug in 3 days, what is the smallest number of days she would need to complete 6 of these rugs?

Mr. Moore deposits $20 in his savings account every week. There are 52 weeks in a year. How much does he put in his account in a year?

Multiplication with Unnecessary Information

A family uses 38 gallons of gasoline on a trip to Oregon. They drove at an average speed of 50 miles per hour for 7 hours each day. How far did they travel per day?

A college student has to type an 8 page paper. The student can type 48 words per minute. If she types for 20 minutes, how many words will she have typed?

Playing tennis uses energy at a rate of 7 calories per minute. Swimming uses energy at a rate of 9 calories per minute. John played tennis for 20 minutes. How many calories did he burn?

A charter fishing boat can take 52 people on an outing. An outing costs $14 per person. Forty-nine people went on an outing. How much did the fishing boat collect?

A grocery sold 82 gallons of milk in a week. There are 4 quarts in a gallon. If each gallon cost $2, what amount was received that week from the sale of milk?

The roasting time of a turkey at 325° is 45 minutes per kilogram. Mrs. Brown bought a turkey that weighed 7 kg. How long should she roast it?

Bill is training for the track team. He runs 15 km every day, 6 days a week. There are 52 weeks in a year. How many km does Bill run in a week?

A 9th-grade class had 18 cakes to sell at a bake sale. If they sold 16 cakes at $3 each, how much money did they make?

Taking a shower uses about 23 liters of water per minute. The shower bathtub holds about 100 liters of water. How many liters of water are used for a 4 minute shower?

The owner of a fleet of taxicabs bought 4 new tires for each of his cabs. He has 22 cabs, 6 of them need radial tires. How many tires in all did the owner buy?

Tammy types at a rate of 42 words per minute. It took her 45 minutes to type a story. The average typist types at a rate of 57 words per minute. How long was Tammy's story?

Division

A person eats about 43,260 grams of beef per year. What is the amount of beef eaten per month?

A farmer bought cows to graze on 78 acres of land. If each cow requires 2 acres of grazing land, how many cows did the farmer buy?

Mt. Whitney is 8,001 m high. The Empire State Building is 381 m high. How many times higher than the Empire State building is Mt. Whitney?

A junior high school ordered 32 science books. The order cost $352. What was the cost of each book?

Joan volunteered to work 32 hours at a hospital. If she can work 2 hours a week, how many weeks will it take her?

Stan must read a 284 page book over the week-end. If he can read 2 pages per minute, how many minutes will he need to read the book?

In a theatre there are 36 seats in each row. How many rows will be used in order to seat an audience of 900 people?

A championship basketball team scored 637 points in 7 games. What was the team's average score per game?

A book club gives its members a discount of $2 on each book purchased. If the total discounts during March were $2,000 how many books were purchased?

During a heavy rainstorm, 8 inches of rain fell at the rate of 2 inches per hour. How many hours did the rainstorm last?

A class of 26 fourth-grade students is going to visit a museum. They will be driven there in cars. Each car can hold 4 students. How many cars are needed?

Division with Unnecessary Information

A stereo costs $750 in cash. If Bob pays for the stereo in 12 monthly installments, it will cost him $960. How much is each monthly payment?

During the season, a football team averaged 26 points per game. In the first 7 games, the team scored 161 points. What was the team's average number of points for the first 7 games?

A motor boat gets 32 km per liter of gasoline. The gas tank holds 40 liters. The boat traveled 896 km. How many liters of gas did the boat use?

Mr. Taylor typically makes 10 business trips per year. On his first trip, Mr. Taylor's car used 62 liters of gasoline to travel 744 km. What was the car's average number of km traveled per liter on the first trip?

Ms. Pearson flew non-stop from Los Angeles to New York, a distance of 3240 miles. She left Los Angeles at 9:00 a.m. The flight took 6 hours. What was the average speed of the plane?

The perimeter of a square parking lot is 120 m. The lot will hold 110 cars. What is the length of each side of the parking lot?

In one month an auto dealer brought in $121,000 from the sale of new cars and $98,000 from the sale of used cars. The average price of the new cars was $11,000. How many new cars did the dealer sell?

An office manager spent $5,488 for 7 electric typewriters and $115 each for 3 calculators. What was the cost of each typewriter?

Multiple Step

A grocer buys a crate of 360 eggs for $18. How much is he paying per dozen?

A hardware store charges $3 for a fluorescent light, $2 for a

furnace filter, and $4 for a screwdriver. Mr. Garcia bought 3 fluorescent lights, 4 furnace filters, and 1 screwdriver. How much change should he receive from $30?

Some students were trying to sell 150 tickets for $5 each and 250 tickets for $4 each. They sold all of the $4 tickets. In all, $1,250 was taken in. How many $5 tickets were left?

During February, 320 microcomputers were shipped to Nevada retail stores and 8 were found to be defective. In March, 210 were shipped and 7 were found to be defective. Of the total number of computers shipped, how many were not defective?

Andrew had a math test on Monday. Out of 16 problems he got 12 correct. On Friday, he had another math test and out of 20 problems he got 15 correct. What was the total number of problems he missed on both tests?

Martin's father bought a TV set for $250. He made a down payment of $50 and paid the balance in weekly payments of $10 each. How many weekly payments did he have to make?

If each box of baseballs contains 12 balls and each carton contains 10 boxes, how many baseballs are there in 6 cartons?

Four boys worked 28 hours on a class project. Bill worked 7 hours, John worked 8 hours, and Don worked 6 hours. How long did the 4th boy work?

A math book is 1 inch thick and an English book is 2 inches thick. There are 28 students in a class and each student has a math book and an English book. If the students stack their books in three equal piles, how high would each stack be?

Two salesmen kept records of how far they traveled in one week. Mr. Brown traveled 95 miles, 46 miles, 53 miles, 71 miles, and 39 miles. Mr. White traveled 87 miles, 43 miles, 66 miles, 59 miles, and 51 miles. How much farther did Mr. White travel than Mr. Brown?

A class of 12 girls and 14 boys are planning a class party at a swimming pool. The class decides that each student should bring $4. If admission to the pool is $2 per person, how much will the class have left for food?

The speed of sound is 4938 feet per second in ice cold water and 12,960 feet per second in granite. In 5 seconds, how much further would sound travel in granite than in ice water?

Multiple-Step with Unnecessary Information

There were 462 boys in an auditorium. There were twice as many girls. Two boys and 4 girls were called out by the principal. How many girls were left in the auditorium?

An airplane must travel 6,400 km. Its average speed is 800 km per hour. How far does it still have to go after it has flown 4 hours at 840 km per hour?

Rita usually bowls about 125. Last night she had scores of 118, 131, and 123. What was her average score last night?

Mario has 253 stamps in his collection including 39 duplicates. He exchanged 25 of his duplicates for 13 new stamps from Pura. How many stamps did Mario then have in all?

Tony wants to earn $30 to buy some records. He agreed to paint a fence for $45. If he spent $3 for a paint brush and $15 for the paint, how much profit did he make?

A school library has 250 books. The librarian discovered that 37 books had been borrowed but never returned. She announced 2 "free" days on which books could be returned without paying the fines. On the first day, 12 books were returned. On the second day, 15 books were returned. How many books were still missing?

Howard worked 10 hours last week. He earned $15 running errands and mowed 5 lawns at $4 each. How much more money does he need in order to buy a $40 watch?

A choral group sold 250 tickets at $6 each, 400 tickets at $5 each, and gave each member 5 free tickets. They paid $100 to rent an auditorium for the concert. How much money did the group make?

Three automobiles and 4 buses are used for transporting people to a convention. Each bus has 12 rows of 6 seats. How many people can travel to the convention in buses?

A baseball team plays 110 games in a season. If they have scored 195 runs in the 65 games they have won and 135 runs in the 45 games they have lost, what is their average number of runs per game?

FRACTION PROBLEMS

Addition

Sam used 6/8 of a tank of gasoline to drive to Las Vegas. On the return trip, he took a different route and used 1 1/8 tanks of gasoline. How many tanks did he use in all?

Tom played one record for 3/12 of an hour and another record for 1/12 of an hour. During what part of the hour was he playing records?

When you exhale, about 18/25 of the air is nitrogen and 4/25 is oxygen. What part is either nitrogen or oxygen?

A nature study group hiked for 1 2/5 hours, rested for 1/3 hour, then hiked for 1 2/3 hours. How long did it take them to complete the trail?

George bought 2 steaks at the grocery. One weighed 1 3/4 lbs. and the other weighed 2 3/4 lbs. How many pounds of steak did he buy?

If it takes 3/4 of an hour to wash the car, and 1 1/2 hours to wax the car, how long will it take to do both?

Mrs. Burns is planning to drive to Monterey by going through San Jose. The trip to San Jose takes 1 1/4 hours. The trip from San Jose to Monterey takes 1 1/4 hours. How long will it take Mrs. Burns to get to San Jose?

Jane is 2 1/2 years old. Her brother is 4 1/4 years older than Jane. How old is her brother?

Karen ate 1/3 of a mushroom pizza and 1/6 of a cheese pizza. What part of a whole pizza did she eat?

Addition with Unnecessary Information

Mrs. Smith paid $8 for a chocolate cake and $7 for an orange cake for her daughter's birthday party. If the guests ate 3/4 of the orange cake and 5/8 of the chocolate cake, how many total cakes did they eat?

Mrs. Jones is making meat loaf for dinner. She plans to use a 3/4 lb. package of ground beef, another 1/2 lb. package of ground beef, and a 1/4 lb. package of ground pork. How much ground beef will there be in the meat loaf?

Tom is paid $4 per hour for yard work. If he spent 1/4 hour cutting his neighbor's front lawn, 1/4 hour trimming the hedge, and 1/2 hour cutting the back lawn, how much time did he spend cutting his neighbor's lawn?

Paul jogged 13 blocks in 1/4 hour. The next day he jogged 24 blocks in 3/8 hour. How long did he jog in all?

A cake recipe calls for 2 1/4 cups of flour and 1 1/2 cups of sugar. The icing takes 3/4 cup of sugar. How much sugar is needed in all?

An oak tree in Robert's backyard is 8 1/3 feet tall. A birch tree is 7 3/4 feet tall. If oak trees usually grow 1/2 foot per year, about how tall will the oak tree be next year?

After school Ann read 200 pages of a book in 1 2/3 hours. After dinner she read 175 pages in 1 1/4 hours. How long did she spend reading?

Joan baked 48 cookies. She used 2/3 cup of brown sugar, 1/3 cup of granulated sugar, and 1/2 cup powdered sugar for the icing. How much sugar did she use in all?

Subtraction

On a trip, the Hameltons spent 3 1/5 hours on an airplane. For 2/5 of an hour, the plane was on the ground. How long was the plane in the air?

Scott studied in the library for 3 1/3 hours. Laura spent 1 2/3 hours at the library. How much longer was Scott at the library than Laura?

A direct flight from New York to Los Angeles took 4 2/3 hours. A flight with a stopover in Chicago took 6 1/3 hours. How much time did the stopover add?

A light blue mixture of paint was made by mixing 1 5/8 cans of blue paint with white paint. How much white paint was used if the final mixture filled 4 7/8 cans?

Brad has a piece of rope 22 1/2 inches long. He cut off a piece 4 1/4 inches long. How long is the rope that is left?

Mary Ann wants to lose 10 lbs. After 2 weeks she had lost 2 3/4 lbs. How many more pounds does she have to lose?

Subtraction with Unnecessary Information

A 7th-grade class went on a hike. They walked for 1 1/3 hours, rested for 1/2 hour, and then walked back to school. If they were gone 3 3/4 hours, how long did they walk?

In a track meet, Fred jumped 4 1/4 feet. Jim jumped 4 3/8 feet. Last year Jim jumped 4 1/8 feet. How much further did Jim jump this year?

The hiking club planned a 3-day trip from their campsite to Stone Lake. The first day they hiked 8 1/2 km. and on the second day they hiked 7 3/4 km. How much further did they hike the first day?

Dan and Dick had to write book reports for English class. Dan spent 3 1/2 hours reading the book and 1 3/4 hours writing his report. Dick spent 3 1/4 hours reading the book and 2 1/3 hours writing his report. How much longer did it take Dick to write his report than it took Dan to write his report?

In an election for mayor, 11/20 of the voters voted for the Democratic candidate, 7/20 voted for the Republican candidate, and 1/10 for an Independent candidate. How much larger was the share of the total vote received by the Republican candidate than that received by the Independent candidate?

On Saturday, Tricia and her brother went skiing. Tricia skied 1 1/2 hours less than her brother. Her brother skied for 3 1/4 hours, ate lunch for 3/4 hour, and then drove Tricia home. How long did Tricia ski on Saturday?

Robin can run 2 miles in 11 minutes. Robin's younger brother is slower. He runs 2 miles in 13 1/2 minutes. If they start running at the same time, how long will Robin wait at the finish line for her brother?

Marcel practiced 3 piano pieces for the recital. He practiced the first piece for 1 1/2 hours, the second piece for 3/4 of an hour, and the third piece for 3/4 of an hour. How much longer did he spend practicing the first piece than the second piece?

Multiplication

A school dance was attended by 2/3 of the students in the school. Of those attending, 1/2 had helped decorate the hall. What fraction of the total number of students in the school helped with the decorations?

Sue answered 9/11 of the questions on a test correctly. If the test contained 22 questions, how many questions did Sue answer correctly?

One foot of copper wire costs 12 1/4 cents. What is the cost of 8 feet of copper wire?

Before the basketball game started 8/13 of the seats were filled. The gym has 221 seats. How many seats were filled?

Susan had $32 to spend. On a shopping trip she spent 3/4 of her money. How much did she spend?

There are 35 students in a high school band. 2/5 of the band members play the trumpet. How many students play the trumpet?

A tourist rents a car for $24 a day. How much will it cost for 3 3/4 days?

There are 35 people in Sara's class. 3/5 voted to hold the class party next Tuesday. How many students voted for Tuesday?

Ross rode 6 1/2 km on his bike. Dave rode 1 1/2 times as far as Ross. How far did Dave ride?

Multiplication with Unnecessary Information

Yesterday, Anne read 1/4 of a 200-page book. Today Ann read 1/2 as much as yesterday. What fraction of the book did Anne read today?

To make one cake you need 1 1/4 cups of flour and 3/4 cups of sugar. How much flour would you need for 3 cakes?

Joe ate 1/2 of a 5 oz. candy bar yesterday and saved the rest for today. Today he ate 2/3 of the amount he had saved. What fraction of the whole candy bar did Joe eat today?

Sandy usually swims 2/3 of a mile each morning. But today she stopped swimming after going 4/5 of the way. Her swim took 20 minutes. How far did Sandy swim today?

A store has 10 Michael Jackson record albums on sale for 3/4 of the regular price. If the regular price of an album is $8, what is the sale price?

Eric's motorcycle gets 50 miles per gallon of gasoline. His tank holds 3 1/2 gallons. If he buys 2 1/2 gallons of gas, how far can he go?

Jerry worked 2 1/2 hours and washed 24 windows. If he was paid $4 per hour, how much did he make?

The Smith Company has 300 employees. 7/10 of the employees live less than 3 miles from the plant. Of these employees, 5/6 commute to work by bus. All other employees drive to work. What fraction of the employees commute by bus?

Mr. Clark works 6 1/2 days a week. If he earns $12 per hour, how much would he earn in a 7 1/2 hour day?

In 120 times at bat Harold has gotten a hit 7/20 of the time, struck out 1/20 of the time, and been put out 3/5 of the time. How many hits did Harold get?

Division

A mechanic charged $20 for working 2/3 of an hour on a car. If the mechanic had worked 1 hour on the car, how much would he have charged?

Sandra practices the piano 1 1/2 hours each day. How many days will it take her to practice a total of 24 hours?

How many glasses of orange juice are in 2/3 of a pitcher, if each glass holds 1/8 of the pitcher?

A coffee pot holds 60 cups of coffee. How many people can be served from this coffee pot if each person drinks 2 1/2 cups of coffee?

John rode his moped 45 miles in 1 2/3 hours. How far did he go per hour?

Bill wants to record a rock concert which will last for 3 hours. One stereo tape will record 1 1/2 hours. How many tapes should Bill take to the concert?

Ms. Wallace is knitting an afghan. She wants it to be 77 inches long. She can knit about 2 3/4 inches per day. How many days will it take her?

Leroy walks 4 1/2 miles in 2 1/4 hours. How fast is he walking per hour?

Division with Unnecessary Information

The Trent family is planning to drive 200 miles in 3 3/4 hours. There are three people in the family and each wants to drive. If they split the driving time equally, how long would each person drive?

Mr. Spade took 1 1/2 hours and 2 gallons of gasoline to drive 90 miles. What was his average speed for that trip in miles per hour?

Joe, Mary, and Jim pooled their money and bought 1/2 of a pizza for $3. If they split the pizza equally, what fraction of the whole pizza did each person eat?

John worked 10 1/2 hours in the first half of the month. On each day that he worked, he worked 1 1/2 hours. On how many days did he work?

A pitcher holds 1 1/2 quarts of orange juice. How many glasses of orange juice are in 1/2 pitcher, if each glass is 1/6 of the pitcher?

The gas tank of Howard's VW holds 9 1/2 gallons. How many trips to the beach can he make on 1/2 tank of gas if each trip takes 1/8 of a full tank?

A 5 lb. bag contains 22 1/4 cups of flour. How many loaves of bread can Terry make from 2/3 of a bag flour if each loaf takes 1/6 of a full bag?

Troy had 1/2 of a 16 ounce bag of peanuts. He divided the peanuts evenly between his 2 sisters. What fraction of the whole bag did each sister get?

Multiple-Step

On a high school football team, 9/20 of the team members are seniors, 8/20 of the team members are juniors, and the rest are sophomores. What part of the team are sophomores?

A gardener planted 3/8 of a plot with tomatoes, 1/6 with beans, 1/12 with peppers, and the rest in lettuce. How much of the plot was used for lettuce?

A recipe for lemonade calls for the juice from 1 lemon, for every 2 1/4 cups of water. The juice from 1 lemon is about 1/4 cup. How many cups of lemonade can be made from the juice of 8 lemons?

A mover charges customers $26 per hour for driving time plus the cost of tolls. How much would he charge for 6 1/2 hours driving and tolls of $3?

Each moving truck can carry 150 crates. How many crates would there be in 8 trucks if 5 were full trucks and 3 were 4/5 full?

The regular price of headphones is $30. If they are on sale for 1/3 off, how much will they cost?

Rose has a 5 lb. bag of flour. She wants to bake a cake that uses 7/8 lb. of flour, some bread that uses 1 1/4 lbs., and some cookies that use 1/2 lb. How much flour will she have left after she bakes the cake, bread, and cookies?

Larry keeps a record of the time he spends doing homework. Last week he spent 1 1/2 hours on Monday, 1 1/2 hours on Tuesday, 2 hours on Wednesday, 1 3/4 hours on Thursday, and 3/4 hour on Friday. What was the average time per day he spent on homework for the 5 days?

Bill gave 1/3 of his jelly beans to a friend, ate 2/3 of the remaining jelly beans, and had 8 jelly beans left over. How many jelly beans did Bill have originally?

A movie theater which has 400 seats was 3/4 full last night. Of all the people at the movie theater 2/3 bought popcorn. How many people bought popcorn?

In a school computer club, 1/5 of the members were in the 7th grade, 2/7 were in the 8th grade, and the rest were in the 9th grade. What part of the members were in 9th grade?

A man planted 1/8 of his flower garden with roses, 1/4 with marigolds, 3/8 with petunias, and the rest with pansies. How much of this garden was planted with pansies?

A plumber earns $24 per hour for the first 40 hours worked each week and 1 1/2 times that for each hour over 40 hours. How much would the plumber make in one week if he worked 43 1/4 hours?

An airplane has 35 first class seats and 150 tourist class seats. On a flight to Reno, 3/7 of the first class and 2/3 of the tourist class seats were occupied. How many seats were occupied?

John has a part-time job at a grocery store. Last week he spent $15 of his pay on a new sweater. This left him with 3/5 of his weekly salary. How much does John earn each week?

Multiple-Step with Unnecessary Information

Amy is 14 years old. On Friday night she babysat for 3 1/4 hours. On Saturday night she babysat for 2 1/2 hours. If she is paid $4 per hour, how much money did she make?

George has been collecting coins for 6 months and has 100 coins. 2/5 of George's coins are from foreign countries and the rest are from the U.S. How many U.S. coins does George have?

Mrs. Kelvin, an English teacher, assigned her class 100 pages of reading over the weekend. Arim read for 2 hours every night to finish this assignment. On Friday night he read 1/3 of the book. On Saturday night he read 5/12 of the book. What fraction did he have to read on Sunday night in order to finish the book?

Lou worked 2 1/2 hours picking strawberries at his uncle's farm. He can pick 10 cartons in 1 1/4 hours. How many hours will it take for him to pick 15 cartons?

Jane bought a bag of 24 caramels. She ate 1/8 of the bag. She met 2 friends and shared with them 1/2 of the caramels that were left. What fraction of the bag did she share?

Jerry had 24 math problems for homework. If he studied for 1 1/2 hours and completed 2/3 of the math problems, how many problems did he still have to do?

A concert hall which has 400 seats was 4/5 full last night. Of the people there, 1/4 had free tickets for the show. The tickets cost $10 each. How many people had free tickets?

A school computer club has 150 members. 1/5 of the members were in the 7th grade, 2/7 were in the 8th grade, and the rest were in the 9th grade. What fractional part of the members were in 9th grade?

A man planted 1/8 of his flower garden with roses, 1/4 with marigolds, 3/8 with petunias, and the rest with pansies. His garden is 400 square feet. What fraction of this garden was planted with pansies?

Mario spent 2/3 of his savings on a tape recorder that cost $60. The next day he spent 1/2 of what was left in his savings to buy tapes. After these purchases, what fraction of his savings did Mario have left?